U.S. House of Representatives' Science Committee
Subcommittees on Energy and Research
Fueling the Future: On the Road to the Hydrogen Economy

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Thank you, Mr. Chairman and distinguished members of the House Committee on Science.

I am coming before you today to describe our involvement in the Administration's Hydrogen Initiatives, and what DaimlerChrysler is doing to advance the overall hydrogen economy, as well as, address the questions presented to me by the Subcommittee on Research and the Subcommittee on Energy.

What is DaimlerChrysler doing to advance a hydrogen economy?

DaimlerChrysler has been working on fuel cell technology for transportation utilizing hydrogen for over ten years. We have invested over $1 Billion in R&D and have developed five generations of vehicles (NECAR1, 2, 3, and 4). We have 100 fuel vehicles (cars and buses) participating in various international demonstration projects in the United States, Europe, and Asia.

How does DaimlerChrysler participate in the Administration's Hydrogen Initiatives?

As a member of the United States Council for Automotive Research (USCAR), DaimlerChrysler is a partner in the Department of Energy's (DOE) FreedomCAR and Fuel Partnership along with General Motors and Ford Motor Company, and BP America, ChevronTexaco Corporation, ConocoPhillips, Exxon Mobil Corporation, and Shell Hydrogen. DaimlerChrysler has also been working with the DOE since 1993 on advanced automotive technology research. We support the initiative as members on tech teams, including

- Energy Storage Tech Team
- Light Weight Materials Tech Team
- Advanced Combustion Tech Team
- Hydrogen Storage Tech Team
- Fuel Cell Tech Team
- Codes & Standards Tech Team

- Electrical and Electronics Tech Team
- Vehicle Systems Analysis Tech Team

Through these tech teams, we help develop priorities based on future needs and gaps, and manage a portfolio of research projects directed at a set of Research Goals and Objectives.

We also are one of four recipients to participate in the DOE Hydrogen and Fleet Demonstration Project. By the end of 2005, we will have 30 vehicles located in three ecosystems (Southern California, Northern California, and Southeastern Michigan) providing valuable technical data to the DOE.

What criteria does DaimlerChrysler consider when making investment decisions regarding its portfolio of advanced vehicle research and development programs?

DaimlerChrysler uses five factors of measurement to determine investment priority in the advance technology portfolio. They are 1) Probability of Technical Success, 2) Probability of Commercial Success, 3) Value, 4) Business Strategy Fit, and 5) Strategic Leverage.

Figure 1. Investment Priority Factors (to be attached in the final version)

Each of these investment factors is given a score. The weight of each of these five factors is driven by the desired overall investment strategy. An overall score is created and used to compare the projects in a management analysis (portfolio) to aide in the determination of the final investment direction. The over-riding assumption is that we are trying to drive a high percentage of successful investments out of the research program.

What factors would induce DaimlerChrysler to invest more in the development of hydrogen-fueled vehicles?

Several factors could contribute to inducing DaimlerChrysler to invest more in the development of hydrogen fueled vehicles. Key factors include: significant technological advances in fuel cells, hydrogen storage and hydrogen production, major governmental policy support such as incentives, regulatory shifts, customer demand changes, competitive pressures, and significant long term increases in gasoline prices.

What do you see as a probable timeline for the commercialization of hydrogen-fueled vehicles?

The current technology is being evaluated in several fleet demonstration projects around the world. The largest is the DOE's program in the United States. These programs include a few hundred vehicles.

The next phase will utilize technology that address some of the current deficiencies including durability, range, and cold start, as well as, lower cost. This phase will see vehicle numbers in the low thousands.

The next phase which will require further vehicle technical breakthroughs in storage and a significantly expanded infrastructure will move the fleet to tens of thousands.

High volume commercialization will require a highly distributed infrastructure and vehicles that can compete with other fuel efficient technologies. It is likely that this will require continued government policy support.

Figure 2. Commercialization of Fuel Cell Vehicles (to be attached in the final version)

What about the other advanced vehicle technologies DaimlerChrysler is currently developing, such as hybrid vehicles and advanced diesel engines?

DaimlerChrysler is engaged in numerous advanced technologies to enable the vision of sustainable mobility. Fuel cell vehicles are part of DaimlerChrysler's advanced propulsion technology umbrella, which also includes efficient gasoline engines, advanced diesels, and hybrid powertrain systems.

The Multi-Displacement System (MDS) is available in the HEMI and is offered in a significant amount of Chrysler Group vehicles. MDS seamlessly alternates between smooth, high fuel economy four-cylinder mode when less power is needed and V-8 mode when more power from the 5.7L HEMI engine is in demand. This yields up to 20 percent improved fuel economy.

DaimlerChrysler also works on further development of gasoline direct-injection which considerably enhances fuel economy by closely monitoring fuel atomization.

DaimlerChrysler offers five different diesel powertrains in the United States. Advanced diesel technology offers up to 30 percent better fuel economy and 20 percent less CO2 emissions when compared to equivalent gasoline engines. DaimlerChrysler sees advanced diesel as a technology that is available today that can help reduce our nation's dependency on foreign oil.

Designing more engines to run on Biodiesel is a current objective at DaimlerChrysler. Biodiesel fuel reduces emissions of diesel vehicles, including carbon dioxide, and lowers petroleum consumption. Each Jeep Liberty Common Rail Diesel (CRD) built by DaimlerChrysler is delivered to customers running on

B5 biodiesel fuel. Nationwide use of B2 fuel (2 percent biodiesel) would replace 742 million gallons of gasoline per year, according to the National Biodiesel Board.

DaimlerChrysler and GM have recently combined efforts to develop a two-mode hybrid drive system that surpasses today's hybrids. The partnership will cut development and system costs while giving customers an affordable hybrid alternative that improves fuel economy. The first use of the system will be in early 2008 with the Dodge Durango.

What do you see as the potential technology showstoppers for a hydrogen economy?

The most significant technology showstoppers that DaimlerChrysler recognizes as challenging the viability of the hydrogen economy include fuel cell durability, on-board hydrogen storage and advanced battery durability performance. Though there are major efforts and investment being put into fuel cell development, current durability levels are not close to what would be acceptable commercially to customers, both in terms of normal abuse and wear as well as overall life expectancy. No current on-board hydrogen storage system meets the FreedomCAR and Fuel Partnership targets for cost and performance. To obtain customer expectations for driving range a fairly large amount of hydrogen is required to be stored on-board, therefore compromising passenger compartment space. Additionally, the current high-pressure storage tanks available have manufacturing processes that take multiple days per tank. The on-board hydrogen storage tank industry currently does not have the capacity to support even low-volume production levels. Alternative methods of storing hydrogen on-board are critical to the hydrogen economy. While several advancements have been made in battery technology in recent years, the current level of technology does not support performance requirements for power, energy and durability.

In addition to the technology challenges identified above, the cost challenges associated with these technology challenges are at least as significant.

To what extent is DaimlerChrysler relying on government programs to help solve those technical challenges?

DaimlerChrysler realizes that the technical challenges associated with moving towards the hydrogen economy are too great and too costly for any one company to solve. Additionally we see no benefit in multiple companies working independently in pre-competitive technology development. Due to the enormity of this transition, DaimlerChrysler actively participates in USCAR with Ford Motor Company and General Motors and in the FreedomCAR and Fuel Partnership with the other USCAR members as well as the U.S Department of Energy, BP

America, ChevronTexaco Corporation, ConocoPhillips, Exxon Mobil Corporation and Shell Hydrogen. The research required to solve the technical challenges of the hydrogen economy is universally viewed as “high risk” by industry. The research sponsored by DOE through the FreedomCAR and Fuel Partnership provides a forum to pull together some of the best minds and organizations involved in advancement of the hydrogen economy to help address that risk.

How are automakers using, or how do they plan to use, the advanced vehicle technology developed for hydrogen-fueled vehicles to improve the performance of conventional vehicles?

As stated earlier, DaimlerChrysler is working on a broad portfolio of technologies to improve the efficiency and emission of transportation. In the short-term we continue to improve the internal combustion engine (ICE). In the mid-term we are developing hybrid vehicles utilizing electric drive systems, integrated power modules and advanced batteries. In the long term fuel cell vehicles with on-board hydrogen storage from a national hydrogen infrastructure will emerge.

The current portfolio of R&D within the DOE’s FreedomCAR and Fuel Initiative is focused on the long term hydrogen vision but many of the technologies are useful and can mature in the shorter term and transition technologies. Cost effective, light-weight materials can benefit current, transition and fuel cell vehicles equally. Advanced electric storage and motors will benefit hybrid and fuel cell vehicles. Novel approaches to hydrogen storage are uniquely required by hydrogen fueled vehicles, but can support a transitional hydrogen powered ICE.

It is important to advance and mature many of the aspects of the technology as early as possible. There are many challenges and breakthroughs needed to realize the President’s vision of a “Hydrogen Economy”.